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**Scale Development in the Gulf Menhaden,  
*Brevoortia patronus***

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## Scale Development in the Gulf Menhaden, *Brevoortia patronus*

As part of the Bureau of Commercial Fisheries research on menhaden in the Gulf of Mexico, the pattern and sequence of scale formation were studied in larval and juvenile Gulf menhaden, *Brevoortia patronus*. Suttkus (1956) reported that a Gulf menhaden measuring 26.8 mm standard length (or about 30 mm fork length) possessed scales, but he did not indicate their location or extent. This report provides information on the manner of scalation and minimum size of fully scaled individuals. Such information facilitates the use of scales in determining ages and computing growth.

Sample material consisted of 146 menhaden collected along the Texas coast in April 1964 and April 1965, and distributed about evenly over a range of 15 to 35 mm fork length. The specimens were cleared in a 3% solution of hydrogen peroxide for about 1 hr and then stained with alizarin red to facilitate identification of scales.

Two species of menhaden occur along the Texas coast, the Gulf (largescale) menhaden, which is by far the predominant commercial species, and the finescale menhaden, *B. gunteri*. The juveniles and adults of these species can be readily identified (Hildebrand, 1963), but not their larvae. Arnold et al. (1960) concluded that the larval menhaden in collections from Galveston Entrance during 1953–58 were Gulf menhaden because only this species, as juveniles and adults, had ever been observed in the Galveston area. Since my material was collected in the same locale, I made the same assumption.

The largest fish without any scales measured 22 mm, the smallest with at least one scale, 21 mm. The first scales form single rows on the sides of the belly between the pectoral and pelvic fins (Figure 1). The fork lengths and scalation of fish were as follows: 21 to 22 mm—scales only along the belly; 22 to 23 mm—three or four rows of scales on the lower lateral surfaces of the body from a point above the base of the pectoral fin posteriorly to the anal fin, and a single row on the caudal peduncle; 23 to 24 mm—scales

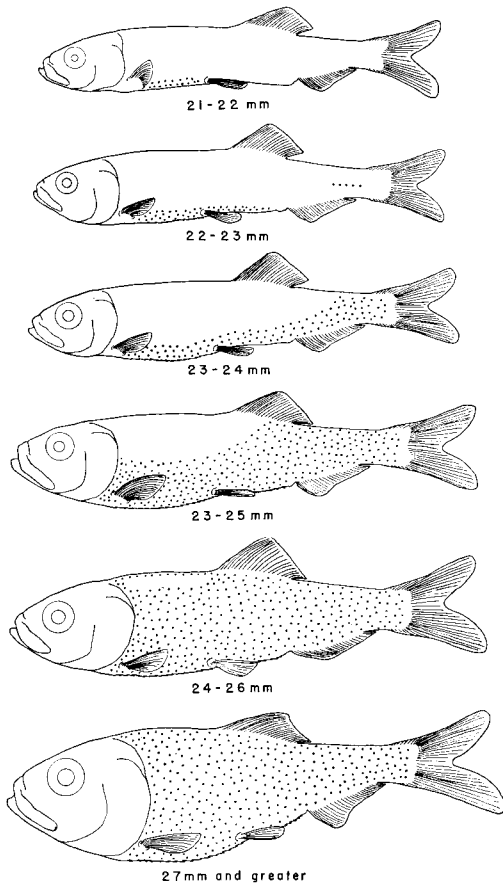


FIGURE 1.—Sequence of scale formation in *Brevoortia patronus*. Speckling indicates area where scales occur.

cover the caudal peduncle as well as the area just above the vent and along the base of the anal fin; 23 to 25 mm—scales cover the remaining area below a line from the insertion of the dorsal fin to a point located midlaterally just behind the head (Figure 1 clearly indicates that scales of fish in this size range continue to appear anteriorly and dorsally); and 24 to 26 mm—fully scaled except for a small area of the back on each side of the paired rows of predorsal scales. The smallest fully scaled fish measured 25 mm; all fish 27 mm and larger were completely scaled.

No measurable difference was observed in the sequence or extent of scalation between fish collected in 1964 and those collected in 1965. Measurements of scale number, diam-

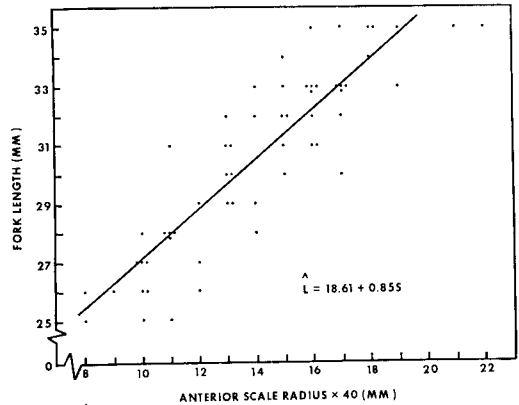


FIGURE 2.—Relation of fork length of fish and anterior scale radius in juvenile *Brevoortia patronus*.

eter, and location indicate that scales on both sides of the same fish appeared and developed at about the same rate. Newly formed scales on fish 21 to 22 mm are elliptical, granular, and translucent, have no circuli or ctenii, and measure from 0.32 to 0.45 mm in greatest dimension. On fish 22 to 23 mm, the scales behind the pectoral fins decrease in size posteriorly from 0.45 to 0.14 mm diameter, whereas those on the caudal peduncle are larger posteriorly and decrease anteriorly from 0.23 to 0.14 mm. On fish 23 to 25 mm, scales 0.40 to 0.45 mm in diameter are imbricated.

Scales on the lateral surfaces form in diagonal rows corresponding to the myotomes. Those above the horizontal skeletogenous septum are arranged diagonally and slant dorsally and posteriorly, whereas those below the septum slant ventrally and posteriorly. Scales on the back, along the belly, around the opercular cover, and near the fin bases are not evenly spaced but appear bunched. These scales are generally smaller than those on the lateral surfaces and usually are of irregular shape.

To determine the average relation between size of fish and size of their scales, I examined the scales of 58 menhaden 25 to 35 mm long. The scales were removed from the midlateral area just forward of the dorsal fin. The regression of fork length ( $L$ ) on scale size ( $S$ ) proved linear and is expressed by the equation  $L = 18.61 + 0.85 S$  (Figure 2).

These findings are important for two rea-

sons: First, because the Gulf menhaden is generally considered to be a winter-spawning fish (Hildebrand, 1963; Suttkus, 1956) and scales have been shown on young-of-the-year collected in April, it may now be safely assumed that scales from larger and older individuals carry growth histories that begin with the first spring of life. Second, the intercept value of 18.61 (19) permits more accurate calculation of growth of scales of Gulf menhaden.

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